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Developing baseline design criteria for people with lower body mobility impairments using inclusive design

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An estimated 3.5 million people in the United States use a wheelchair to assist them with mobility, and that number continues to increase (U.S. Census Bureau, 2013). People who use wheelchairs face several clothing-related problems, such as dressing and undressing, fit, comfort, and ease of movement while in the wheelchair (Kabel, Dimka, & McBee-Black, 2015; Radvan, 2013). However, relatively few mainstream brands consider the needs of people with disabilities when producing their mainstream apparel collections. This study aimed to develop a set of inclusive clothing design criteria that may be used by mainstream apparel brands to create clothing items which are acceptable for both mainstream and specialized markets. This research focused on developing apparel design criteria for men with lower-body mobility impairments (LBMI) and use a wheelchair to assist in mobility.

Mainstream vs. Specialized clothing. Clothing brands which develop apparel for people with special needs have primarily focused on comfort and utility of the garments, and the items are thus more likely to stand out from other "normal" clothing; therefore, the garments may be viewed as unattractive or unfashionable (Kabel, Dimka, & McBee-Black, 2015). Most apparel designed for people with disabilities does not conform to mainstream styles and trends. Some studies have pointed out that "differently" developed clothing items were not widely adopted by people with disabilities because it may cause inner stigmatization for the wearers (Wingate, Kaiser & Freeman, 1986). The exception is Tommy Hilfiger who in 2016 launched an adaptive apparel line for people with disabilities, making the brand's products easier to put on and take off through a magnetic closure system but still conforms to their brand aesthetics (Brinkley, 2016). Past authors have suggested that clothing designed for people with disabilities should attempt to follow conventional dressing norms to reduce the feeling of being different (Radvan, 2013; Hernandez, 2000). Keates and Clarkson's (2003) Inclusive Design Cube (IDC) model was used to develop a set of inclusive clothing design criteria for people with LBMI.

Inclusive Design Cube (IDC). The Inclusive Design Cube (IDC) illustrated in Figure 1 is a methodological design model for a practical inclusive design approach (Keates & Clarkson, 2003). The IDC represents three levels of ability including users' sensory, cognitive, and motion capabilities. Moving from the core to the exterior levels, the IDC visualizes increasing levels of disability. To be specific, the x-axis addresses sensory capability, the y-axis addresses motion capability, and the z-axis addresses cognitive capability. This model may be useful for mainstream RTW apparel brands regarding who and how many people are able to use their products, allowing designers to improve or redesign their products with a better understanding of

users' capabilities. In this study, the researchers used the IDC to expand the scope of apparel products to include a larger variety of users.

The research questions which guided this study were: (a) what are the clothing-related issues for people with LBMI? (b) what types of design elements or techniques have adaptive clothing brands adopted to address the needs of people with lower-body mobility impairments? and (c) What baseline design criteria can be developed for producers of mass-produced apparel to use when creating inclusive apparel?

Methods. The research procedure consisted of two phases of exploratory qualitative research: (a) in-person interviews with men who use a wheelchair, and (b) a content analysis (Krippendorf, 1980) of adaptive apparel brands websites, products, and popular press articles. For the interviews, the researchers recruited, seven male participants between the ages of 22-61, who voluntarily participated in semi-structured interviews. Five interviews were conducted in-person at a public place or interviewees' offices for their convenience, and two interviews were conducted by phone because the participants were out of town. All of the participants had lower-body mobility impairments with chronic physical limitations. The participants used a wheelchair for mobility between 3-36 years and spent approximately 14.7 hours a day in their wheelchair. For the content analysis, twelve brand statements, three articles with interviews of adaptive-clothing designers, six articles introducing the adaptive clothing brands yielded 155 representative items with no duplicate features for analysis.

Results. This research found that there have been discrepancies between adaptive market and people with LBMI regarding social conformity. In addition, it defined functional clothing issues of people with LBMI: clothing fit, dressing and undressing, sensory sensitivity, thermal protection, ease care, and storage. Many of the participants were deeply involved with local communities as workers or students and therefore, cared deeply about both the functional and symbolic aspects of their apparel. The participants preferred to purchase and wear mainstream RTW apparel because it appealed to their diverse tastes and preferences while some of the participants do not know exactly about adaptive clothing either have negative perceptions of it.

Based on the findings, the researchers suggested baseline design criteria. The criteria met the apparel needs of both people with LBMI while also considering mainstream users in accordance with the IDC model. To be specific, as the guidance of the model, the criteria were suggested along with mobility and sensory capabilities.

Implications of Research. This research expects that the set of inclusive clothing design criteria if accepted by mainstream apparel producers, will reduce the gap between apparel requirements of people with LBMI and the mainstream market. These criteria provide mainstream designers with additional information to consider when they design their products.

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